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# **China in Space**

## **Civilian and Military Developments**

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and

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## *Foreword*

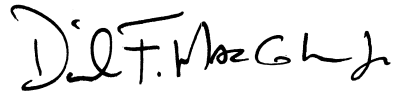
In October 1956, Mao Tse-tung ordered the start of China's space program. Four years later, on 5 November 1960, China launched its first rocket, becoming the fourth country, behind Germany, the United States, and the Soviet Union, to enter space. Today China routinely launches space satellites for Western companies, including US corporations, and is increasing its share of the global space launch market. But the Chinese also use the technology and assistance gained in foreign ventures for PRC military applications. And a principal organization in China's space effort, the China Great Wall Industry Corporation, has been identified by the US State Department as engaging in missile technology proliferation activities.

How does China's space effort fit into its overall development strategy? What is China doing in military space applications? These are the two principal questions addressed, in order, by Lt Col William R. Morris and Col David J. Thompson, both of whom traveled to the PRC in the spring of 2001.

Lt Col Morris examines the relationship between China's evolving space effort and its national development goals. He shows how the Chinese have used their space launches both for fund raising and employment activities, and as a foreign policy tool: Beijing now has space-related technical and economic cooperation with over 70 countries. But the Chinese also use spin-offs and pirated technologies from space operations to enhance their imagery, signals, and communications intelligence. The author also speculates that the Chinese may be developing electronic pulse weapons and laser dazzlers that could degrade an adversary's satellites.

Col Thompson, in his concentrated focus on China's military space applications, examines PRC ground, space, counterspace, and space policy aspects. His principal findings: China has plans to construct a new launch site in the deep south; PRC telemetry, tracking and command capacities are improving; China has the ability to conduct limited intelligence, surveillance and reconnaissance missions from space; the PRC is pursuing a counterspace capability most likely using satellite jammers and anti-satellites (possibly parasitic or nano-satellites). Col Thompson concludes that while China's space program does not now constitute a global threat, the PRC is pursuing space capabilities that will increase its regional influence, and deny an adversary certain uses of space.

As with all Maxwell Papers, this study is provided in the spirit of academic freedom, open debate and serious consideration of the issues. We encourage your responses.

A handwritten signature in black ink, reading "D.F. MacGhee Jr." in a cursive, slightly stylized script.

DAVID F. MacGHEE, JR.  
Major General, USAF  
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Colonel David J. Thompson, USAF, graduated from the University of Northern Colorado in 1978 and earned Masters Degrees at Central Michigan University and the Naval War College. A Navigator and Specialist in Space Operations, Colonel Thompson's experience includes C-130 and T-43 aircraft, and Spacelift Range Operations. Previous assignments include Director of Operations, 3rd Space Ops Squadron, Schreiver AFB, Commander, Detachment 4, Ascension Island, Commander, 45th Range Squadron, Patrick AFB, and Military Staff Assistant, OSD/Operational Test and Evaluation, Pentagon. Colonel Thompson is a graduate of the Air War College, Class of 2001.

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**THE ROLE OF CHINA'S  
SPACE PROGRAM IN ITS  
NATIONAL DEVELOPMENT  
STRATEGY**

Lieutenant Colonel William R. Morris, USAF

On 8 October 1956, the Central Committee of the Communist Party of China, presided over by Mao Tse-tung, established the Fifth Research Academy of the Ministry of National Defense to develop a space effort.<sup>1</sup> This was the official beginning of the People's Republic of China (PRC) space program. Just four years later, on 5 November 1960, China launched its first rocket becoming the fourth country behind Germany, the United States, and the Soviet Union, to enter space.<sup>2</sup>

The Chinese space program has survived periods of traumatic upheaval during its 44-year history. Today, space is the cornerstone of China's national science and technology development effort.<sup>3</sup> Beijing is advancing China's space program on a number of fronts hoping to become a recognized international space power.

The Chinese leadership under Jiang Zemin wants China to become a strong, modern, and ultimately wealthy nation, in short a "great power." Given its natural resources, manpower, nuclear forces, seat on the UN Security Council, and growing economy, China wants "parity" with other great powers. To do this Beijing has crafted a national development strategy led by certain sectors. The purpose of this paper is to discuss how China's space program aids the government in reaching for great power status.

### **China's National Development Strategy**

In the 1970s and 1980s, Deng Xiaoping's advisers, picking up where Zhou Enlai had left off, developed a method of calculating China's national strength based on four subsystems of national power. Put into practice, the strategy was termed the "Four Modernizations."<sup>4</sup>

A RAND Corporation study terms the Chinese approach a "calculative" security strategy. It is pragmatic, emphasizing the primacy of internal economic growth and stability, international relations, relative restraint in the use of force, while increasing efforts to modernize China's military forces.<sup>5</sup> The element of greatest importance remains economic power. Beijing continues to place priority on efforts to promote rapid and sustained economic growth, to raise technological levels in sciences and industry, while developing and gaining access to national and global resources. As CCP General Secretary Jiang Zemin said in his closing speech to the Central Committee of the 14<sup>th</sup> Party Congress in October 1992, "National defense construction and the construction of the military must rely on economic construction, and be subordinate to the overall situation in the construction of the national economy. Only when the national economy has developed can we provide the necessary material and technical basis for national defense modernization."<sup>6</sup>

While defense modernization, on the other hand, is lower on the official priority hierarchy, in the aftermath of Operation ALLIED FORCE in Kosovo numerous Chinese officials pushed for upgrading the PRC's national defense. Nevertheless, at the August 1999 leadership retreat at Beidaihe, the senior leadership elite reaffirmed its customary priorities.<sup>7</sup>

The Gulf War also had been a revelation to the Chinese – an introduction to 21<sup>st</sup> century tactics and weaponry that pointed out, in the most graphic way, the limits of China's massive but antiquated military.<sup>8</sup> Then came Operation ALLIED FORCE, clearly reemphasizing the need to improve the People's Liberation Army (PLA) in precision-guided weapons, advanced information technologies, and high-technology weapons. Beijing is reforming China's defense industries to gain a self-sufficient defense technology and production capability in keeping with the emerging "revolution in military affairs."

In March 2001, during the Ninth National People's Congress (NPC), President Jiang Zemin again emphasized China's goals of development, economic restructuring, reform, opening-up, and technological progress.<sup>9</sup> So, at least rhetorically, China is reiterating the primary tenets of its 20-year-old national development strategy.

But at the Ninth NPC it also was announced that defense spending would increase by 17.7%. Talking to senior PLA officers at the Academy of Military Sciences (AMS) in Beijing in March, they stated that a majority of that increase would be dedicated to salaries and personnel retention.<sup>10</sup> But we also know that substantial areas of China's actual defense spending are "off budget." This lack of transparency into PRC defense spending (and space is related to defense) makes detailed PRC space spending hard to estimate.

## China's Space Program

The RAND Corporation defines spacepower as the *pursuit of national objectives through the medium of space and the use of space capabilities*. Developing a strategy for spacepower must include consideration of economic and political security interests as well as military goals and objectives.<sup>11</sup> Space-related functions include commercial, civil, international, scientific, intelligence, and other military specific matters.

China's November 2000 White Paper on space activities states, "The Chinese government attaches great importance to the significant role of space activities in implementing the strategy of revitalizing the country with science and education and that of sustainable development, as well as in economic construction, national security, science and technology development and social progress."<sup>12</sup> Thus development of a viable



space force is seen as integral part of China's national development strategy.

### **The Beginnings**

The recognized father of the Chinese space program is Tsien Hsue-shen, born in 1911. Tsien moved from China at the age of 24 to study aeronautical engineering at the Massachusetts Institute of Technology (MIT) and later at the California Institute of Technology (CalTech). Shortly after receiving his Doctorate in 1939, Tsien Hsue-shen's interest in rocketry began.<sup>13</sup> He was deeply involved in US rocket and jet propulsion programs during the 1940s. In May 1945, with the fall of Germany, Tsien was given the rank of temporary colonel in the US Army to evaluate the German rocket programs.<sup>14</sup>

But Tsien was subsequently caught up in the post-World War II fears of communism and Senator Joseph McCarthy's witch-hunts. In August 1955 Tsien was deported to China.<sup>15</sup> A year later Mao Tse-tung formally established China's space development program. Tsien Hsue-shen's return to China may have been a serious factor in Mao's decision and timing.

Dr. Yanping Chen, in the May 1991 issue of *Space Policy*, divides China's space program into four distinct periods.<sup>16</sup> The first period, 1956-1966, saw the Chinese establish a space program in spite of the trauma from Mao Tse-tung's "Great Leap Forward" and withdrawal of Soviet support. Loss of Soviet access was a real setback for China's science and technology efforts.

The second period, 1966-1976, witnessed China's space program maintain a progressive course even though sectors of Chinese society were being torn apart by Mao's "Great Proletarian Cultural Revolution." A notable accomplishment occurred on 24 April 1970 with the successful launch of China's first Earth satellite on the Long March-1 rocket. However, the Cultural Revolution profoundly diminished the number of students in China's technical schools and universities; again, China's space program was set back for years.

The third period, 1976-1986, was an ambivalent period for the space program as China's recovery from the Cultural Revolution slowly proceeded under Deng Xiaoping's leadership. As recently as August 1978, Deng had stated, "As far as space technology is concerned, we are not taking part in the space race. There is no need for us to go to the Moon and we should concentrate our resources on urgently needed and functional practical satellites."<sup>17</sup> So China's space budget was trimmed to meet more modest ambitions.

With the reductions in space spending (and budgeted defense spending) in the early 1980s, came Beijing's authorization for China's space agencies to generate income from external sources. On 29 January

1984, the newest Long March-3 launcher vehicle inaugurated the Xichang facility in south-central China.<sup>18</sup> Following a successful launch, China began offering Long March launchers to the West. In effect, China's space program was shifting orientation from the defense sector to the civilian and commercial sector.

According to Yanping Chen, the final period of China's space development, beginning in 1986, has become the "heyday" of the space program. China had received little response to the offered launch services until a series of events occurred in 1986. They began with the disastrous loss of the United States space shuttle *Challenger*. Then two of America's other leading rocket launchers, a Titan and a Delta, spectacularly exploded. Compounding these problems, Europe's Ariane also went down. Western companies in a hurry to launch satellites and facing increasing delays turned to Russia and China, about whose capabilities they knew little.

The China Great Wall Industry Corporation (CGWIC) has been actively marketing PRC launch services since those unfortunate events. The world's space failures in 1986 made the versatile and flexible Long March family of launch vehicles attractive to the international market. The first launches for paying customers involved experimental payloads using the Long March-2, first for a French company (Matra) in 1987 and then for a German consortium (Intospace) in 1988.<sup>19</sup> China's Space Leading Group (SLG), under the State Council, was established in 1991. The SLG's primary purpose has been to oversee and coordinate all space activities in a broad policy-making role.<sup>20</sup> The Space Leading Group also has the responsibility for attracting foreign contracts. The Chinese National Space Administration (CNSA), established in 1993, is the executive agency for space functions responsible to the Premier who also sits on the Space Leading Group.<sup>21</sup>

Revenues earned by China's commercial launches are shared between two government organizations, the Commission of Science, Technology, and Industry for National Defense (COSTIND) and the China Aerospace Corporation (CASC). Within CASC, profits are shared between the Chinese Academy of Launcher Technology (CALT) entities involved in manufacturing the launch vehicle; CGWIC, as the marketing and contracting agent; and CASC headquarters.

## Economic Impacts

China's first 10 space launches grossed approximately \$500 million, or an average of \$50 million per launch. With the cost of each Chinese launch vehicle estimated at \$5 million to \$10 million, the commercial launch business is extremely profitable.<sup>22</sup> In November 2000 Beijing reported that China had launched 27 foreign-made satellites into space,

thus acquiring a significant share of the international commercial market.<sup>23</sup> There are a number of contracts either signed or under negotiation. By 1999, China had launched 7% of the total satellites put up in the world. With demand for satellite launch services booming, China is continuing to increase its share of the global market in the 21<sup>st</sup> century.<sup>24</sup>

With relatively lower labor costs, and propped up with government subsidies, the CGWIC offers very attractive launch fees to the international market. China's economy gets a financial boost, an influx of technology, and world recognition. By agreement with the US in 1994, however, Beijing is only allowed to price launches 15% below the market to protect US launch companies from unfair pricing.<sup>25</sup> US manufactured products on satellites launched by any other country also require an export license that must be granted by Washington. These two factors have limited China's ability to seize a larger share of the world's space launch market.

China's space industry has benefited economically from its reinvigorated space program in several ways. Conducting research and development on space systems, building varying missile and guidance systems, building satellite systems, building space launch complexes, and operating and maintaining the space launch and control systems are all vital to a space program and involve high-technology workers. So not only are jobs created, but also the "pull" from the space program fosters better educational institutions and more graduates. Marketing this capability brings income into government agencies, which feeds further space development.

Specifically, CASC and its sub-contracted industries have an estimated 270,000 employees. By 1986, the Chinese were able to identify 1800 spin off-items generated by the space industry.<sup>26</sup> The space program has accelerated the pace in a wide range of Chinese industrial technologies and products. For example, it has driven development of computers, modern electronics, precision engineering, chemicals, and high-strength materials.

Until recently, communication and broadcasting capabilities in China were very poor. The great expanse of China is characterized by many remote districts and varied terrain making it difficult to connect ground-based systems. However the use of operational satellites is resulting in rapid development of telecommunications, television, and radio broadcasting in China. Traditional ground-based systems are being skipped for satellite systems. One analysis shows traditional systems would cost twice as much and provide only 80% coverage as opposed to 100% coverage for a satellite system.<sup>27</sup> Launched satellites for civilian and government use today include telecommunications,

television broadcasting, meteorology, natural resources, earth observation, and scientific experiment.

The Chinese are attempting to overcome their huge technology lag by uniting with other countries in joint ventures. Beijing has promoted technical and economic cooperation and exchanges to jointly develop satellites and other space related articles with more than 70 countries and regions.<sup>28</sup> Commercial collaboration in other industries such as aviation also has helped the PRC achieve significant improvements in process and quality control standards.<sup>29</sup> For example, China gained experience from the bi-national effort to produce and launch the China-Brazil Earth Resources Satellite (CBERS).

### **Technical Challenges**

During the mid-1990s, China experienced a rash of mishaps and failures in its space program. Several of these incidents involved US-built satellites being destroyed or damaged. The loss of confidence by commercial contractors, and by the Chinese themselves, forced a rigorous program overhaul dealing with quality control and launch safety. The program was put under international quality standards, additional quality checks, and a redesign of the guidance systems. These steps have improved China's space program in both quality and success.

Several incidents involved the US firms of Loral Space & Communications Company and Hughes Space & Communications Company. After a 1995 accident, Hughes engineers determined that the Chinese had been using an "oversimplified" model to predict the effect of wind shear and other forces on their rocket launches.<sup>30</sup> Following a second failure in 1996 of their Intelsat 708 satellite launch, Loral formed a review committee of representatives from several aerospace companies to evaluate China's investigation of the launch. The Loral report gave feedback to the Chinese regarding other suspected causes of failure. With Loral and Hughes having vested interests in the future success of China's space launch program, the Chinese in effect got outside technical assistance from two prominent US companies.

But a variety of technical problems continue. For example, "kick motors" are designed to boost satellites from geosynchronous transfer orbit (~600 miles high) up to geosynchronous orbit (~22,300 miles high) using solid rocket propellant. These motors need to have the correct grain structure and shape to produce exactly the right amount of thrust for the right amount of time. Chinese "kick motors" are considerably behind US-designed motors in accuracy and detail. A lack of confidence has had foreign firms wanting to first validate the propellant and witness test firings of the Chinese motors. These certifications have resulted in more reliable, efficient kick motors as well as other solid-rocket motor designs for the Chinese.<sup>31</sup> Whether that improve-

ment is due to export of technology, espionage, or national scientific advancement (or some combination), the results indicate the Chinese are progressing.

The US House of Representatives felt it necessary to look into how far Loral and Hughes had gone in identifying problems and assisting the Chinese in rectifying their rocket launch failures. The *Final Report of the Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China*, more commonly referred to as the "Cox Report," made a number of charges against both China and several US organizations. The Cox Report dealt with technology acquisition related to China's nuclear weapons, missile, and satellite development. "To acquire US technology the PRC uses a variety of techniques, including espionage, controlled commercial entities, and a network of individuals and organizations that engage in a vast array of contacts with scientists, business people, and academics."<sup>32</sup> Although most of the Cox Report's allegations were not proven, and remain disputed within US government and business circles, one thing is clear – the Chinese are advancing their space capabilities by whatever means possible.

### **International Impacts**

China's international space activities in government-to-government agreements and business joint-ventures now include Australia, Brazil, Canada, Chile, France, Germany, Italy, Japan, Kazakhstan, Pakistan, Russia, South Korea, Sweden, and the United States. These relationships have earned China a level of respect and esteem they clearly desire in the modern high-technology world.

Nevertheless, the US State Department identified CGWIC as one of two Chinese entities engaged in missile technology proliferation activities.<sup>33</sup> With China selling missile systems and missile technology to countries the US considers "rogue states," such as Iraq, Iran, and North Korea, Washington was forced to impose trade sanctions on the PRC in accordance with the Arms Export Control Act. These sanctions included denial of license applications for export items of US-made satellites to be launched on Chinese launch vehicles covered by the Missile Technology Control Regime (MTCR). Ultimately Beijing made concessions, agreeing to abide by the MTCR, "on principle."

In 1997 it was reported that China put its first satellite monitoring station abroad in the South Pacific. The ground station, located on South Tarawa Island belonging to the Republic of Kiribati, has commercial and military strategic significance. The station conducts a variety of missions to include satellite control, data downlinks, and data intercepts for the China Satellite Launch and Tracking Control General (CLTC).<sup>34</sup> This government agency has the responsibility to track and

control China's domestic satellites through a network of locations. The South Pacific location is also ideal to track and monitor US satellite and rocket launches from Vandenberg AFB, California, and other US Navy communications. It is unconfirmed as to the existence of any related Chinese intelligence collection, but the site has raised suspicion.

CLTC recently reached a cooperation agreement with the Swedish Space Corporation (SSC).<sup>35</sup> This agreement allows each organization to purchase services from the other's network of control centers and ground stations. This expands China's network potential and serves to enhance their international reputation.

## **Technology Gains**

With the end of the Cold War, the US economy underwent a major transformation. To stay alive and relevant, defense firms had to increase their sales in the commercial and overseas markets. Former Secretary of Defense Perry realized it would be necessary to compromise and open up to a greater flow of dual-use technologies abroad to maintain the US defense industry base.<sup>36</sup>

China obviously has benefited from this greater US openness. A great deal of technology being applied to commercial space systems can be carried over to military systems. An imagery satellite, for example, whether it is being used for military or civilian purposes, requires the same basic technical capabilities for gathering data. A rocket launch vehicle delivering a civilian satellite to space or a ballistic missile delivering a nuclear warhead also are largely identical in forms of rocket science, guidance technology, environmental stresses, etc.

The United States is rightfully concerned with Chinese dual-use and pirated technologies being garnered in commercial space programs as demonstrated by events leading up to the Cox Report. Dual-use technologies have accelerated China's technological advancements. It is, however, strongly believed that the Chinese still lag behind. A Nixon Center report released in 2000 concluded that, "The reality is that the technological gap between the Chinese and the US is most likely growing," particularly in such areas as computers, satellite communications, and precision-guided munitions.<sup>37</sup>

## **Military Significance and Space Capabilities**

American forces in Operation DESERT STORM clearly demonstrated the significant contribution and value of space assets to military forces. US satellites served as valuable force multipliers to operational commanders and personnel. Space forces provided time critical data and information related to ballistic missile attacks, worldwide communications, up-to-date weather information, pinpoint navigation and positioning, and vital intelligence and reconnaissance information about

Iraqi forces and assets. The Chinese clearly understand this. Moreover, Chinese strategists appear to have grasped the concept of space dominance. PLA leadership acknowledges space as an essential dimension of regional warfare.

For example, in 2000 the PRC Defense Minister said that spacepower is viewed as the key to China's planning to supplant the United States.<sup>38</sup> PLA doctrine would deny the advantages of space to the US, seeking to leverage space for China's own advantage. This is in direct confrontation with the recently released Rumsfeld Commission report characterizing space as a "vital national interest" for the United States.<sup>39</sup> As the Hong Kong newspaper *Sing Tao Daily* reported in January 2001, "to ensure winning in a future high-tech war, China's military has been quietly working hard to develop asymmetrical combat capability [sic] so that it will become capable of completely paralyzing the enemy's fighting system when necessary by 'attacking selected vital points' in the enemy's key areas."<sup>40</sup> This correlates to CIA Director George J. Tenet's February 2001 testimony before the Senate Intelligence Committee that weaker foreign militaries view US space systems as a key vulnerability during potential conflicts.<sup>41</sup>

The Chinese Academy of Space Technology (CAST) is responsible for spacecraft production including satellites. China has launched three basic types of satellites: imagery intelligence (IMINT), signal intelligence (SIGINT), and communications. The imagery intelligence satellites are the Fanhui Shi Weixing (FSW) recoverable satellite series. By mid-1999 a total of 17 FSW-class launches had occurred with 15 successful recoveries.<sup>42</sup> These photo reconnaissance satellites orbited the earth for up to 16 days before recovering to have their recorded images developed. Resolution quality and the recovery requirement are signs of the lagging capabilities.

China also is pursuing higher resolution imaging capabilities with remote sensing to expand their usefulness. Another IMINT area being pursued is synthetic aperture radar (SAR) capability. A radar satellite will not only provide imagery in a different spectrum, but will have all-weather, round-the-clock capabilities.

The Shi Jian (SJ) series of spacecraft are considered to be a SIGINT category of satellites. China's SJ-2 satellite was first launched on 20 September 1981 in an orbit characteristic of an electronic intelligence (ELINT) mission. The SJ-2 is China's first suspected SIGINT satellite.<sup>43</sup> Beijing has not pursued space-based SIGINT systems as they have ground, air, and sea platforms, but efforts are believed to be underway.

The Feng Huo-1 (FH-1) satellite is the first space-based communication platform for China. This satellite was launched in January 2000 as the first of several military communication satellites being part of the

Qu Dian command, control, communications, computer, and intelligence (C4I) system.<sup>44</sup> Qu Dian will provide commanders a capability to communicate and share information with their theater forces in near-real time. This system may afford a huge advancement in the communication field to the PLA.

China is emphasizing dual-use systems, which provide benefits today and potential benefits to future PLA operations. For example, the PRC has deployed advanced imagery reconnaissance and earth resource systems. These can be used to advance their economy, agriculture, and environment management today, but they also have potential military applications tomorrow. The CBERS system, mentioned earlier, also can provide militarily useful data although it was developed under the premise of bi-national cooperation and non-military use.

China's aerospace industry is seeking to integrate global positioning system (GPS) and Russian Global Navigation Satellite System (GLONASS) guidance technology into their jet fighters and helicopters. Loath to be dependent on foreign systems, China is developing its own navigation satellite constellations. The Twinstar Rapid Positioning System, or Beidou Navigation System (BNS), consists of just two satellites in geosynchronous orbits. The first satellite of the Twinstar system, the Beidou Navigation Test Satellite-1 (BNTS-1), was successfully launched on 31 October 2000.<sup>45</sup> China's first satellite navigation system was completed with the BNTS-1B launch and successful deployment was on 21 December 2000.<sup>46</sup>

With just two satellites, the BNS is a very rudimentary satellite navigation system. Li Hairu, Deputy Chief Designer, states the system's primary purpose is for highway and railway transportation within China and seafaring in the Pacific Ocean.<sup>47</sup> The positioning accuracy is very coarse, but it does provide all-weather, round-the-clock operation. Most importantly, however, it is the first indigenous Chinese system.

For greater accuracy, a follow-on system consisting of four satellites in geosynchronous orbit is already planned.<sup>48</sup> Lessons learned from the BNS will surely be applied for any follow-on system. Both of these systems will only provide regional navigation services, rather than worldwide navigation capability. Of course Chinese plans could change and a more robust system be deployed, but several possible factors affect the decision of the Chinese to deploy these limited systems. The US and Russian global navigation satellite systems could continue to be utilized to support worldwide needs. There are additional technical requirements and tremendous associated costs with deploying a global system that simply may not be justifiable. Perhaps most importantly, China's military has shown no explicit expeditionary ambitions, and thus its worldwide navigational needs are minimal.



The counterspace arena also is receiving PRC emphasis. For several years it has been reported that China has been acquiring a variety of foreign technologies which could be used to develop an anti-satellite capability. Vice Admiral Thomas R. Wilson, Director, Defense Intelligence Agency, reported in February 2000 to the Senate Intelligence Committee that China had "across-the-board programs" underway to develop weapons and systems to attack and counter US satellites and space sensors.<sup>49</sup> CIA Director George Tenet and Admiral Wilson believe that by 2015 adversaries will be able to employ a wide variety of means to disrupt, degrade, or defeat portions of US space support systems.

China is suspected of developing ground-based laser weapons and electronic pulse weapons that could blind or destroy satellites.<sup>50</sup> A weapon does not need to destroy a satellite to render it useless, just damage the susceptible optical sensors. The closer Sino-Russian relationship also is contributing to China's advancement, as Russia turns the former Soviet Union's tremendous Cold War research and development budgets and technological advancements into economic gains.

It is also accepted that China possesses laser dazzlers capable of degrading or defeating the ability of adversary satellites to gather intelligence. The *Sing Tao Daily* reported in January 2001 that China had ground tested a potentially very potent satellite weapon called a "parasite satellite." This micro-satellite could attach itself to a targeted satellite with the intent of jamming or destroying it under command.<sup>51</sup> These types of systems tend to confirm US intelligence suspicions that space will be a new theater of warfare.

Some senior PLA officers, evidently, prefer the US to believe otherwise. Chinese officers recently refuted any counterspace goals of the PRC and challenged Americans not to believe everything we read from their press.<sup>52</sup> This obvious propaganda directly contradicts what the PRC government and national press have reported numerous times in the recent past, as well as American intelligence reporting.

So China is addressing the demands of 21<sup>st</sup> century warfare. Such things as small booster systems that will be available on short notice for contingency support are being developed. Protective measures for satellites such as small size thermal shielding, and EMP protection, are being implemented.<sup>53</sup> Recently there were reports that "radiation-hardened" integrated circuits were shipped to China through Singapore from a US company.<sup>54</sup> Beijing can be expected to aggressively continue acquiring modern weapons-related goods from the US and others for its space and military modernization programs.

## Future Plans

The Chinese people's dream of space flight may be characterized as originating with the famous legend of Goddess Chang'e flying to the Moon.<sup>55</sup> On 20 November 1999, China began that journey with the launch of its unmanned spacecraft named Shenzou, or "Vessel of the Gods." The spacecraft is designed to carry China's first astronauts, or "taikonauts," to the Moon in the near future. The Project 921 spacecraft has obvious Soyuz-like design characteristics, thus hinting at a substantial amount of Russian assistance. This first unmanned flight from the Jiuquan Satellite Launch Center in northwest Gansu province orbited the Earth 14 times before landing 21 hours later.<sup>56</sup> Although unmanned, it has major military and commercial implications.

After much delay and anticipation the Shenzou-2 (SZ-2) launch occurred on 10 January 2001, the second unmanned launch.<sup>57</sup> During the nearly 7 day voyage, various subsystems for manned flight were tested. Chinese press reports indicate mice, plants, and other organisms were along for the ride. While the Chinese media insist it was a perfect mission, no pictures of the re-entry capsule have been released.

The global applause that Communist Party officials in Beijing were hoping for did not materialize. Despite Beijing's public optimism, technical problems, funding shortages, and political interference are expected to continue hampering China's man into space program.<sup>58</sup>

The first two Chinese taikonauts are active-duty PLAAF fighter pilots trained in Russia. China has initiated its own training center with a group of other candidates for the future manned spacecraft program. Russian technical and cooperative assistance is evident.

China also has mentioned becoming involved in the international space station, exploring deep space, and even setting up a permanent lunar base by 2015 to mine Helium-3 from the Moon's soil, an excellent fuel source for nuclear fusion plants, producing virtually no radioactive by-product.<sup>59</sup> A space shuttle load of Helium 3 could supply US energy needs for a year, according to Apollo 17 astronaut Harrison Schmitt.<sup>60</sup>

## Conclusion

The People's Republic of China's space program has come a long way since its birth in 1956. From humble beginnings, periods of meager budgets, political chaos, and shortages of well-educated engineers and scientists, the space program has somehow managed to continue, and today it thrives. The Soviet Union and the United States developed their large space programs around national security needs. Moscow and Washington, as of late, have carried over that technology into commercial sectors of their economies. Beijing, on the other hand, has

its space program focused around China's national development strategy, prioritizing the economy first.

The economic benefits of space to China have come in a variety of ways – from commercial services, to jobs programs, to improving educational programs, to industry spin-offs and more. Joint ventures and international agreements have improved China's stature and global respect. These features combined with other ongoing Chinese efforts to acquire information, whether it be in the form of technical assistance, scientific advancement, technology transfer, or even espionage, are enabling China to further advance its military space assets and capabilities.

In the United States, the National Reconnaissance Office has pursued space-based capabilities for 40 years because President Dwight D. Eisenhower and his successors clearly understood the significance of space reconnaissance to our national security. Today, China also shares a doctrine that views space as vitally important to its national security, and as an arena for competition. China's space industry will remain an integral part of the nation's comprehensive development strategy.

## Notes

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<sup>53</sup> Stokes, 173-174.

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**CHINA'S MILITARY SPACE PROGRAM**  
**Strategic Threat, Regional Power, or National**  
**Defense?**

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The People's Republic of China (PRC) is attempting to emerge as a major world player in a number of commercial and military arenas. Of special concern to the United States is China's potential as a peer or near-peer competitor in military space operations. This paper reviews the basic elements of China's space and counterspace programs in order to assess current and near-term capabilities. Also outlined is China's national space policy to discern the leadership's likely intent for future military use of the space medium. Discussion concludes with an overall assessment of China's probable future as a potential peer-competitor to the United States in military space operations.

Not discussed are information operations, computer network attack or defense, or intercontinental ballistic missiles. Although these missions are assigned to space forces in the United States, they are not inherently space operations and are not included in this review of China's space program.

Much of the information presented here is speculative due to the closed nature of the Chinese government. This is further complicated by the particularly guarded nature of PRC military activities and developments. However, the available information does allow one to make a basic assessment of China's current and near-future status in military space operations.

## **Ground Segment**

The Chinese space program's ground segment consists of three elements: launch sites, launch vehicles, and telemetry, tracking, and commanding (TT&C) and space surveillance sites. We discuss each segment followed by an assessment of current and likely future status.

### **Launch sites**

China currently has three primary satellite launch centers, each designed to handle specific types of missions. The Xichang Launch Center, located in Sichuan Province in southern China, supports all launches into geostationary orbit. The two launch pads at Xichang recently underwent extensive modernization and expansion in order to handle new rocket variations as well as support commercial customer needs.<sup>1</sup> The Chinese put Xichang off limits to foreigners during this period.

The Jiuquan Space Facility, located in Kansu Province near the southern edge of the Gobi Desert, was first designed to support surface-to-surface and surface-to-air missile test and operational launches. In April 1970 China launched its first satellite, a DFH-1 communications satellite, into orbit from Jiuquan. The facility now has three pads used

to launch satellites into low altitude, posigrade orbit with inclinations greater than 40 degrees.<sup>2</sup>

The Taiyuan Satellite Launch Center, located in Shanxi Province 250 miles southwest of Beijing, has a single pad from which satellites are launched into sun-synchronous orbit<sup>3</sup> and polar orbits.<sup>4</sup> The site is also used for Inter-Continental Ballistic Missile (ICBM) and Submarine-Launched Ballistic Missile (SLBM) tests.

There are indications that China may soon undertake construction of a new, fourth, launch facility in the southern coastal province of Hainan.<sup>5</sup> This location would help alleviate logistical and safety problems associated with the existing sites. Current sites are all inland and can be difficult to reach. Additionally, their inland locations create safety hazards for people living beneath the launch vehicle flight path. A launch failure in 1996 resulted in the death of several, possibly dozens of civilians.<sup>6</sup>

China's existing three launch sites are capable of placing satellites into every type of militarily useful orbit. However, the sites do not provide a great deal of launch redundancy for each type of orbit. Additionally, problems noted with accessibility and safety may limit China's ability to create a launch "surge" in time of need. Launches take place on a long term planning basis as China does not currently have a "launch on need" capability.<sup>7</sup> As with all static, above ground launch facilities, China's launch facilities are highly vulnerable to attack from both conventional and unconventional forces.

## Launch vehicles

China has developed a relatively impressive inventory of launch rockets for its military and commercial satellites. Although the overall launch success rate is only between 80%-90%, and recent launch rates have been even worse, China has sought in recent years to improve its launch capabilities. This is especially true in the areas of low-earth (LEO) and geosynchronous (GEO) orbits. Domestic launch rates are historically in the low single-digits each year. China currently can launch the following maximum payloads:

LEO	25,000 kg*
Polar Orbit	2,500 kg*
GEO-Transfer	4,000 kg

\*The large difference between LEO and polar-orbit payloads is a launch site limitation and not a launch vehicle limitation.



China has the capability to launch major payloads into all militarily useful orbits, giving them the potential to provide all their launch needs domestically. However, their low launch rate and relatively poor launch success rate, coupled with their lack of launch surge capabilities, indicate China would fight wars in the near term with assets already in place or planned for launch in the immediate future.

### **TT&C and Space Surveillance**

A major but little discussed element of all space programs is the TT&C and space surveillance element. This capability allows personnel on the ground to track rockets and payloads in flight, assess conditions during launch, and take corrective actions. The TT&C sites enable ground controllers to communicate with satellites in orbit, assess satellite health, command orbit and payload adjustments, as well as other activities. The space surveillance portion of this ground element provides position and orbit data to assist authorities in keeping track of their own, as well as other nations', satellites. China currently employs approximately 20,000 personnel within its TT&C and space surveillance system.<sup>8</sup> The primary facility is the Xian Satellite Monitor and Control Center. Additional sites are located at each launch facility as well as numerous sites dispersed across China, including some mobile and ship based systems.<sup>9</sup> Recent upgrades include the addition of S-band tracking radars and the addition of new tracking stations.<sup>10</sup> Also, China recently completed an agreement with Sweden for a mutual ground station support program.<sup>11</sup> This is in addition to space-related cooperation agreements already worked with other nations.<sup>12</sup>

The Chinese TT&C and space surveillance system is a generally capable distributed system. The system not only gives China the ability to control its own satellite constellations; it allows the Chinese insight into the on-orbit activities of other nations. One use of such information might be to track and target foreign military satellites in the event China develops a capable anti-satellite program. Forging ties to other countries like Sweden may be part of a major effort to increase China's ability to observe satellites worldwide, as well as provide TT&C and space surveillance system redundancy in the event her domestic systems are targeted by enemy forces.

## **Space Segment**

The term "space segment" refers to the on-orbit satellite portion of the space program. For simplification, satellites have been grouped into four general categories: 1) communication, 2) navigation, 3) intelligence, surveillance, and reconnaissance (ISR), and, 4) weather.

## Communications Satellites

China has successfully launched at least 11 different variants of Chinese built communications satellites. Although the majority of the PRC's efforts have been commercial ventures, several have been either primarily or solely for military use. The satellites with the greatest military utility include two-way communications satellites, data relay satellites, and direct broadcast satellites. Recent improvements include use of the ultra-high frequency (UHF) band, a band that provides the military with some increased protection against signal intercept and jamming.<sup>13</sup> There is evidence that China is seeking to procure satellite-hardening technology illegally through Hong Kong in order to further improve its space communications security.<sup>14</sup> This technology will be necessary for the satellites to operate under high electromagnetic pulse conditions that might be expected in future wars.

China has not developed the reliance on communications satellites to the same degree as the United States. Perhaps partly as a result, current Chinese communications satellites lack much of the design and technical performance capability of western satellites.<sup>15</sup> While this leaves Chinese communications satellites somewhat vulnerable to jamming, interference, and interception efforts, China's lesser dependence on space communication systems also means they would be less impacted by an adversary's hostile space activities. Additionally, China's security involves mostly internal lines of communications where fiber optics and other reasonably robust legacy forms of communications links are very viable.

## Navigation Satellites

China launched its first navigation satellite, the BNTS-1, on October 31, 2000. A second satellite, launched on December 21, completed the twin-satellite, geostationary navigation and timing system.<sup>16</sup> The system will provide 24-hour coverage over a limited geographic region in the Chinese mainland and some surrounding waters. Although the Chinese system does not provide the global coverage and degree of accuracy gained by the US GPS system, deployment of this Chinese built system indicates China has both the intent and capability of deploying an indigenous satellite navigation system. Neither the full capability of the system, nor its schedule for deploying further navigation satellites is known.

Two observations occur regarding the Chinese navigation satellite system. First, it is clear that China wishes to develop its own space-based navigation capability so as not to be vulnerable to a US decision to employ GPS selective availability during times of crisis. China, like most countries of the world, is rapidly becoming more dependent on

the position and timing information provided by GPS. Secondly, the choice of a geostationary system with limited geographic reach is a clear indication that for now and the foreseeable future China is content to restrict military activities to within or close to its own borders.

### **Intelligence, Surveillance, and Reconnaissance (ISR) Satellites**

Although public sources are meager about the technical specifics of China's ISR programs, it is known that China is working on developing several ISR satellites systems. Although we cannot determine the truth of this statement, an unnamed "Chinese military expert" went so far as to state to the *Sichuan Youth Daily* newspaper in late 1999, "If the US seeks to intervene militarily into the internal affairs of China and Taiwan, they will find that the entirety of their global movements are seen by Chinese satellites."<sup>17</sup>

China began retrieving imagery intelligence from low-earth-orbiting satellites in 1975. In all, 17 photoreconnaissance satellites have been launched and 15 successfully recovered. The last recovery occurred in 1999.<sup>18</sup> China is currently thought to be working on a next generation imagery satellite, but details are limited to supposition that it will be based on small satellite technology and have 5-meter resolution. Although this resolution may not match other military or even some commercial endeavors, it is sufficient for a large number of military applications. There is some evidence that China may be working on the technology to produce 1-meter resolution. This would place the PRC among the world elite in this category. China does not currently possess real-time satellite photoreconnaissance capability.<sup>19</sup> In addition, there is speculation that China is seeking Russian assistance to develop a high-resolution radar satellite capable of supplementing optical sensors on existing imaging satellites, thus enabling China to take ground images during nighttime or overcast conditions.<sup>20</sup>

Little is publicly reported of China's space-based signals intelligence (SIGINT) or electronic intelligence (ELINT) capability. There is some speculation in open literature, and the Secretary of Defense alluded to such capability in his FY2000 Report to Congress, but nothing of supportable substance is currently available. This is not surprising considering the highly classified nature of these capabilities.

Although the unnamed "Chinese military expert" almost certainly was overstating the situation, China has the capability to conduct limited ISR missions from space, perhaps even on a limited global basis. But without a more extensive network of satellites, real-time photoreconnaissance, or sophisticated SIGINT or ELINT satellites, they remain well behind the US in locating, tracking and targeting the enemy under fluid conditions.

## Weather Satellites

Although not designed primarily for military uses, earth observation and weather satellites do support military activities. As of 1999, China had launched five domestic weather satellites capable of operating in the visible and infrared wavelengths.<sup>21</sup> All weather satellites are listed as part of the Feng Yun (Wind and Cloud) series. Feng Yun-2B (FY-2B), the latest weather satellite, was successfully launched into geostationary orbit on June 25, 2000. FY-2B is the second geostationary weather satellite, replacing FY-2A that was launched on June 10, 1997. The reported design life for FY-2B is three years. During this time, FY-2B will collect and transmit weather images and meteorological, oceanographic and hydrologic information as well as monitor solar activities.<sup>22</sup> In addition to the geostationary satellite, China operates a number of polar orbiting weather satellites which are capable of providing more detailed information on such events as sand storms, fire, and flood.<sup>23</sup> China is also working with Brazil on a cooperative China-Brazil Earth Remote-Sensing Satellite (CBERS) program. Two satellites have been launched.<sup>24</sup>

China has a reasonably sophisticated weather satellite capability not totally unlike that of the US. Designed primarily for civil users, the satellites provide weather and other related data that are vital to military forces when determining useable ground maneuver routes, aircraft flight paths and visible target areas, among other things. Such information is equally valuable in determining the enemy's probable courses of maneuver.

## Counterspace Capabilities

As the US becomes ever more reliant on space systems, there will be more concern about China's ability to impact US operations in space. Although China does not appear to currently possess major counterspace capabilities, there is no reason to doubt that such capabilities are within its technical grasp. Although he did not provide details, Vice Admiral Thomas R. Wilson, Director, Defense Intelligence Agency, in February 2001 testimony before Congress on counterspace programs, noted: "China and Russia have across-the-board programs under way, and other smaller states and non-state entities are pursuing more limited, though potentially effective, approaches."<sup>25</sup> Some of the most likely areas of development are now discussed.

### Satellite Jammers

Interestingly, none of the articles researched discussed the specifics of GPS, communications, or other forms of counterspace jammers.

Even the China portion of the FY2000 Secretary of Defense report to Congress failed to provide any illumination in this area.<sup>26</sup>

My assessment is that despite the lack of available information, this is a very likely key area for future Chinese activities. GPS jammers are available on the world market at low prices and have proved to be highly effective when properly employed. GPS jamming is a major threat as GPS signals are used by most if not all segments of US weapons systems. US military satellite communications systems have some anti-jam protection. The Defense Satellite Communications System (DSCS), Milstar, and other military systems were designed to be jam resistant up to various levels. However, the commercial satellites used by the US and other countries to augment military systems contain no such resistance. It is highly likely that China would seek to prevent the US from using these systems in the event of hostilities.

### **Anti-satellites (ASAT)**

Although not verified through other sources, the Hong Kong *Sing Tao Daily* newspaper quoted unnamed Chinese resources in reporting that China is developing a space-based anti-satellite system. According to the report, the concept is to deploy very small "parasitic" satellites called nano-satellites that would attach themselves to satellites and remain inactive during normal times. Upon activation, these parasitic satellites would destroy the satellite or disrupt its operations.<sup>27</sup> Although the existence of a Chinese parasitic satellite program is uncertain, the existence of micro-satellite programs for data transmission, earth sensing and other programs is well documented.<sup>28</sup> Whether the technology will translate into Chinese ASAT capabilities is not known.

The Secretary of Defense is also concerned that China already may have, or is acquiring, the technology for developing laser radars to track and image satellites. This technology would be of great assistance in targeting orbiting satellites. China also already may have the capability to damage the optical sensors on US systems as they pass over China<sup>29</sup>, and may be developing high-power microwave (HPM) technology to be used against satellites. Additionally, there is speculation China may be researching the use of steel balls to kill a satellite or the use of powder, paint and dust to render a space-based laser ineffective.<sup>30</sup> If developed, these applications also could have an effect on other satellite sensors or solar panels. An additional possibility not mentioned in the literature is use of a nuclear ASAT. China already has such a capability within its ICBM force.

Some ASAT technology, such as ground-based lasers and nuclear ASAT, exists or is well within the reach of China's science community. Other technology, such as applying paint or powder to space-based lasers, seems more challenging. Use of a nuclear ASAT seems unlikely

except as a last resort since its use would be as damaging to Chinese satellites as to an adversary's. Other options requiring short-notice launches are not practical due to current limited launch capability. Another drawback to a "launch to kill" scenario is the ease of determining China's role in such an action as the launch would be seen by one or more US space systems. China is far more likely to develop ground-based lasers and other non-space-based weapons that are cheaper to deploy, easier to control, and leave a less obvious trail back to the perpetrator.

## Space Policy and Strategy

China's space strategy can be expected to reflect its national strategy. According to the FY2000 Secretary of Defense Report to Congress, the Chinese government's national security strategy is focused on becoming the preeminent power in East Asia. The report states the Chinese military strategy includes "fielding forces capable of rapidly deploying to fight and win a future regional war under high-technology conditions along China's periphery."<sup>31</sup> On 22 November 2000, China's State Council published a report entitled "China's Space Activities." It conveys a more benign picture. The report speaks in terms of space education and exploration, and specifically outlines the principle that: "The aim of international space cooperation is to peacefully develop and use space resources for the benefit of all mankind." The report also argues for a fundamental principle of "Persisting in the independence and self-reliance policy, carrying out pragmatic international space cooperation to meet the needs of the national modernization drive and the demands of the domestic and international markets for space science and technology."<sup>32</sup>

China's space strategy and policy appear to be remarkably like that of the US. Since the days of Sputnik, US policy on space has been grounded on the principles of peaceful use of space and right of free passage for satellites. Within that framework, however, the US has prepared for the possibility of war against assets in space by developing and testing aircraft-launched ASATs and ground-based lasers. Other options are almost certainly being explored. In effect, Washington has advocated and hoped for the best while gradually developing the capabilities to cope with space warfare should it become a reality. Like China, the US also shares some of our technology with the world, but takes actions like hardening satellites and imbedding selective availability into GPS to ensure we retain a good measure of independence and control under all conditions. So China's space strategy and policy are not unlike that of the US; Beijing seems to hope for the best, but is gradually preparing for hostilities in space.

## Conclusion

Today China's space program does not constitute a global threat, nor is it likely to become such a threat in the foreseeable future. The PRC has a moderately strong space program that will improve as part of China's overall economic development. Beijing is looking into technologies that will increase the PRC's space capabilities as well as put adversaries' use of space at risk. Some day, China may be able to create major global problems for the US and others. However, without global land, sea, or air capabilities, the military impact of China's space programs is likely to be limited to defense of China's homeland and support of regional activities undoubtedly pointed at Taiwan, the Spratly Islands, Tibet, and other areas of similar proximity and sensitivity to China. In a conflict, China also could assist nations allied against the US by providing launch support, ASAT activities, ISR data, and similar services.

Based on current space and associated military capabilities, PRC policies and historical tendencies, the Chinese space program is likely to increase its regional influence by assuring more freedom of action within Asia while also seeking to deny foreign powers' freedom of action in space, air, land and sea activities. China's drive may not be so much to ensure they become Asia's regional hegemon as to ensure that the United States does not.

Discussions with Chinese and American officials during visits to China and Hong Kong in mid-March 2001 served to reinforce my assessments in this paper. The Chinese space program, like other elements of China's military and economic development, has a very long way to go before it can be considered a true peer competitor of the United States. Nothing learned in the visit indicated China has the air, land, or sea capabilities to support activities outside their immediate region even if they possessed the space capabilities to support such activities. Additionally, Chinese officials repeatedly stated that their national policy has been and will continue to be one of internal vigilance and noninterference in the internal affairs of other nations.

That said, the issue of Taiwan remains of great concern. Taiwan's proximity to mainland China, China's insistence on a "one China" policy that it defines, and the limited expeditionary forces required to cross the Taiwan straits or to blackmail Taiwan constitute East Asia's major flashpoint. These realities require that the US continue to closely watch the progress of China's space and other military programs to ensure Taiwan's security.

## Notes

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